JPL

Terrestrial Planet Finder Mission

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TPF INTERFEROMETER

CRYOGENIC STRUCTURES TECHNOLOGY

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Developing Cryo Structures Technology to Reduce SCI Risk

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TPFI Architecture Team

Technical Concerns

- Stability of long baseline systems
- Stability of cryo hinge/latch components
- Accuracy of modeling tools & predictions

Technology Products

Analysis Tools

- Integrated Modeling (IMOS)
- Nonlinear Analysis (ISYSD)
- Test-Analysis Correlation (ITAP+)

Guidelines

- Design
- Analysis & Models
- Test & Verification

- Req's
- Sensitivities
- Bounds
- Component
- System
- 0g vs 1g
- RT vs Cryo

Testbeds for Product Validation

Cryo/μDyn Physics ⟷ **Components** ⟷ **System**

- Material props (CTE, ζ, …)
- Friction
- Hysteresis & stability

- Hinge/latch
- Damping mitigation
- Sub-assemblies

- SCIT

Cryogenic Structures Technology

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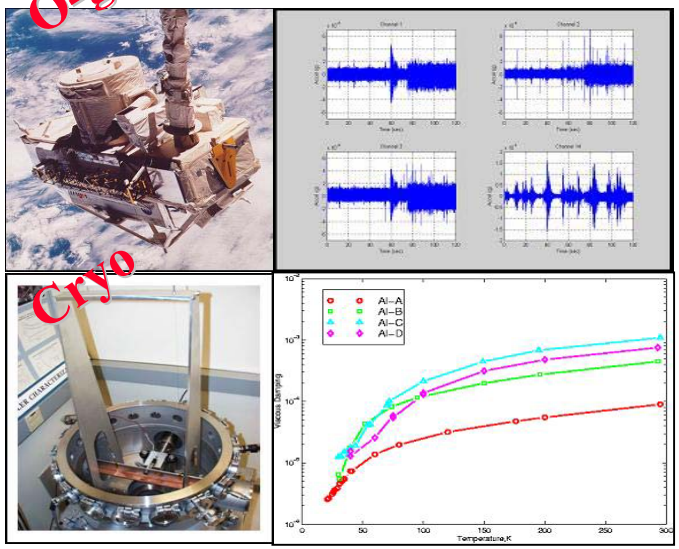

What

- Address concerns expressed by the Design Team
- Develop and experimentally validate analytical methods to predict the physical behavior of large precision deployable structures at cryo temperatures & 0-G:
  - Damping, friction, hysteresis, μdynamics, …
  - Hinge/latch stability & nonlinearities
  - Cryo environment and thermal gradients
  - 1-g to 0-g performance predictions/validation
  - Component to system model complexity

How

- Develop nonlinear FEM methodologies to represent microdynamic behavior of frictional interfaces, and incorporate within Integrated Modeling tools.
- Devise and perform component tests to validate microdynamic model sensitivity to preload (1g vs 0g) and temperatures (RT to cryo). Investigate trends of damping, hysteresis, friction, dynamic nonlinearities, and stability.
- Guide the Design Team efforts in establishing microdynamic sensitivities to key TPFI performance metrics and in defining bounds for the expected microdynamic errors based on known environment.
- Validate system integrated modeling approach on actual test data provided through the Industry Interferometer Testbeds, and perform additional component validation at JPL if necessary.
- Deliver Modeling and Testing Guidelines to the Design Team.